

Articles

Misunderstanding in the Classification of Diabetes Mellitus What's in a Name?

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To assess whether physicians, residents, medical students, hospital diagnosis coders, and patients properly use the designations insulin-dependent diabetes mellitus (IDDM) and non-insulin-dependent diabetes mellitus (NIDDM) that were established by criteria of the National Diabetes Data Group, we reviewed clinic and hospital records and administered questionnaires. Although essentially all cases of true IDDM were identified as such and most cases of NIDDM not requiring insulin therapy were correctly identified by all groups, patients with NIDDM on insulin therapy were misidentified as having IDDM by 38% of residents in internal medicine clinics and 68% of primary care and surgical subspecialty residents. On a survey, of 22 patients with NIDDM on insulin therapy, 17 (77%) considered themselves to have IDDM. Thus, patients who have NIDDM by the established criteria who are on insulin therapy are commonly mislabeled as having IDDM. We present an approach for dealing with this problem by adapting nomenclature focusing on insulin deficiency and resistance. It would probably also be helpful to separately identify the subset of patients with "insulin-deficient diabetes" who are ketosis-prone. It is important to use immunologic profiling (islet cell antibody testing) and insulin sensitivity or deficiency testing (C-peptide levels).

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"But 'glory' doesn't mean 'a nice knock-down argument,'" Alice objected.

"When I use a word," Humpty Dumpty said, in a rather scornful tone, "it means just what I choose it to mean—neither more nor less."

"The question is," said Alice, "whether you can make words mean so many different things."

"The question is," said Humpty Dumpty, "which is to be master—that's all."

LEWIS CARROLL
Through the Looking Glass, 1872

Although it has long been obvious that there are at least two different etiologic forms of diabetes mellitus, nomenclature for these different forms has changed several times. For many years, they were known as juvenile-onset diabetes mellitus and adult-onset diabetes mellitus. These terms were insufficiently precise, as a patient could have a condition physiologically equivalent to juvenile-onset diabetes with its onset at age 25 or 35 (certainly no longer juvenile) or the physiology of adult-onset diabetes with its onset in the teens. Thus, the terms "type I" and "type II" diabetes mellitus were developed, with a more precise pathophysiologic description. These terms were thought inadequately descriptive, so the terms insulin-dependent diabetes mellitus (IDDM) and non-

insulin-dependent diabetes mellitus (NIDDM) were developed by the National Diabetes Data Group.¹ These last terms are now generally accepted and are widely used. Unfortunately, they are frequently misused and misunderstood. This alone would be of no consequence, but the inaccurate use has led to predictable problems in patient care, with ketosis-prone patients on adult services repeatedly receiving insulin far too infrequently and sliding into ketosis during their hospital stay. Insulin-dependent diabetes, originally intended to refer to ketosis-prone patients, has become expanded in common usage to apply to all patients on insulin therapy. We recognized the difficulty that medical students, residents, patients, and medical records coders had in correctly labeling patients with diabetes using the terms IDDM and NIDDM according to standards developed by the National Diabetes Data Group; therefore, we undertook this study to assess labeling of patients with diabetes by physicians, coders, patients, and laypersons.

Methods

To study this problem, we assessed six areas:

- The use of the terms for diabetes mellitus by residents in internal medicine clinic records;
- The use of the terms for diabetes mellitus by resi-

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ABBREVIATIONS USED IN TEXT

IDDM = insulin-dependent diabetes mellitus

NIDDM = non-insulin-dependent diabetes mellitus

dents in university hospital (university medical center) records;

- Coding of the hospital discharge diagnoses of patients by medical records coders in a university medical center;
- The identification of the type of diabetes by internal medicine faculty, residents, and students;
- Understanding of the terms for diabetes by patients with the disorder in internal medicine clinics; and
- Understanding of terms used for diabetes by adults attending a public education session to assess the level or ease of understanding of the terms by the general public, some of whom may have diabetes or are family members of those with diabetes.

The first three were assessed by medical records review, the last three by questionnaires. This study was approved by the Texas Tech University Health Sciences Center (Lubbock) Institutional Review Board.

Definitions

The criteria of the National Diabetes Data Group for IDDM and NIDDM were used as the gold standard for diagnoses of the type of diabetes mellitus in this study.¹ To summarize, IDDM was narrowly defined as ketoacidosis-prone diabetes (from autoimmune islet cell destruction) characteristically but not exclusively presenting in youths and normal-weight or thin persons. Definite NIDDM was defined as diabetes mellitus occurring with a strong component of resistance, often in an obese person, usually beginning after age 40, frequently with some history of the successful use of diet or oral agents, and with no ketoacidosis (except starvation ketosis).¹⁻³ Although the age of onset is not a criterion, this proved so predictive in one study³ that it was used to help classify patients. A diagnosis of "indeterminate" was assigned to those cases where information was insufficient to decide whether the patient had IDDM or NIDDM and for those persons who did not meet the clear-cut criteria for either group. The terms "diabetes," "juvenile-onset diabetes," "adult-onset diabetes," "type I," and "type II" were simply accepted as used in the medical records, by physicians, or by patients.

Medical Records

Clinic charts. In all, 358 records were reviewed over a nine-month period in a university medical clinic. Those records with any form of diabetes on the problem list were pulled for direct review. Information recorded and analyzed for these charts included age, ethnic origin, and sex of the patient, age and presence or absence of obesity at the time of the diagnosis of diabetes, the use of insulin, the use of diet alone or oral agents to control the diabetes, a history of ketoacidosis, and the use of each of the terms for diabetes by each of the physicians seeing the patient.

The data available in the medical record were used to assess whether a patient had IDDM or NIDDM or whether it was indeterminate by the data available.

Hospital charts. Medical records from all patients having any form of diabetes mellitus as a discharge diagnosis from the Texas Tech University Health Sciences Center were identified, and a 100-chart sample was selected for review. Of these, 13 were duplicate entries, 3 were misidentified in some way, and 6 were not available for evaluations, leaving a 78-chart sample from this population, which was reviewed as described earlier. Also noted was whether the patient was on primary care services (internal medicine, pediatrics, or family medicine) or surgery and surgical subspecialties (anesthesiology, ophthalmology, orthopedics, and gynecology). The coded diagnosis (IDDM or NIDDM) was recorded at the time of the hospital records review.

Professional Understanding of Terms

Attending physicians, residents, and students attending (unrelated) medical grand rounds were asked to assign the type of diabetes—IDDM, NIDDM, juvenile- or adult-onset, type I, type II, or indeterminate (multiple answers allowed)—to the following series of case vignettes:

1. A 5-year-old with ketoacidosis and diabetes,
2. A 30-year-old with a new onset of ketoacidosis and diabetes,
3. A 60-year-old obese woman with diabetes for 20 years who has been on insulin therapy for 15 years, and
4. A 40-year-old with diabetes who has been taking oral agents for 20 years.

The case vignettes were designed to represent classic and easily identified IDDM (case 1) and NIDDM (case 4) and easily confused IDDM (case 2) and NIDDM (case 3).

Patient Survey

A total of 45 patients attending internal medicine clinics identified in their records as having diabetes were given a questionnaire to record their age, sex, education, diabetic education, age at diagnosis of their disease, the presence of obesity at the time of the diagnosis, their use of insulin, their use of oral agents, their use of diet alone, history of ketosis or ketoacidosis, and which terms they used to describe their diabetes (multiple answers allowed).

General Public Survey

About 148 persons attending a medical information seminar were given questionnaires with lay versions (omitting the word "ketoacidosis" in case 1 of vignettes) and were asked to choose appropriate labels, with multiple answers allowed to assess whether these terms are currently or easily understood by the general public. Case 2 was not used because it was thought to require a degree of medical sophistication to understand.

Data Analysis

The data from each of these sources were analyzed to assess whether there was adequate information—such

TABLE 1.—Resident Physicians' Diagnoses of Diabetes Mellitus in 76 Patients Seen in Internal Medicine Clinic

NDDG Diagnosis*	Resident Physicians' Diagnosis, No. (%)			
	IDDM	NIDDM	Diabetes Mellitus	Both IDDM and NIDDM
Insulin-dependent diabetes mellitus (IDDM), n = 9	9 (100)	0 (0)	0 (0)	0 (0)
Non-insulin-dependent diabetes mellitus (NIDDM), no insulin therapy, n = 31	0 (0)	26 (87)	5 (13)	0 (0)
NIDDM plus insulin therapy, n = 32	12 (38)	11 (34)	7 (22)	2 (6)
Indeterminate, n = 4	4 (100)	0 (0)	0 (0)	0 (0)

*The diagnosis was established by criteria of the National Diabetes Data Group (NDDG).¹ "Indeterminate" refers to those cases for which insufficient information was available to assign a clear-cut diagnosis.

as the use of insulin, weight and age at diagnosis, or a history of ketoacidosis—to assign a label of "IDDM," "NIDDM," or "indeterminate" by the National Diabetes Data Group criteria.¹⁻³ These labels were then compared with those used by the physicians, patients, or coders. The information was reviewed to determine if there were any systematic biases in the use of these terms.

Results

Records Review

Clinic charts. A total of 358 medical records from October 1989 through June 1990 were reviewed, and 76 cases of diabetes mellitus were identified. Of these, 9 were clear-cut insulin-dependent diabetes; all were correctly identified by this term. "Type I" was also used correctly on one chart (Table 1). Internal medicine residents incorrectly labeled about 12 patients (38%) with NIDDM on insulin therapy as having IDDM.

Hospital charts. In all, 1,084 medical records had discharge diagnoses of "diabetes" for 1990. From these, a sample of 78 were reviewed as described earlier (Table 2). Five records lacked sufficient information to allow a classification of IDDM or NIDDM; all were on insulin therapy, and all were called IDDM by physicians and coded as IDDM. There was no difference in the use of terms by physicians in primary care versus those in surgery and surgical subspecialties. Thus, whereas true IDDM was always correctly identified by physicians and coders, in only 11 of 50 patient records (22%) coded as

IDDM were the cases true IDDM. Physicians were more accurate than coders and did not misidentify any patients who were not on insulin therapy as having IDDM, but they did mislabel 68% (26 of 38) of patients with NIDDM on insulin therapy.

Physician Survey

Of a total of 56 physicians (34 attendings and residents) and medical students (14 third- and fourth-year students) who attended medical grand rounds, 48 returned questionnaires. Of the physicians, only 1 labeled the child with ketosis (case 1) as having NIDDM (Table 3).

On case 2 (a 30-year-old with ketoacidosis and diabetes), of the 28 physicians choosing between IDDM and NIDDM, all but 1 chose correctly; of 21 using the terms type I or type II, again all but 1 chose correctly.

For case 3 (60-year-old woman with diabetes for 20 years who had taken insulin for 15 years), of the 21 physicians using the terms IDDM or NIDDM, 17 used the correct term; they all correctly identified it as adult-onset diabetes; and of 24 using the terms type I or type II, 23 correctly identified type II. Of the medical students, 8 identified NIDDM, all used the term adult-onset, and 10 of 12 choosing between types I and II correctly identified type II.

For case 4 (40-year-old man with diabetes on oral diabetic therapy for 20 years), none of the physicians used an incorrect term. Of the medical students, all choosing between IDDM and NIDDM chose correctly, and 1 of 8

TABLE 2.—Discharge Diagnoses of Diabetes Mellitus on a Sample (n = 78) of Medical Records, by Different Terms and Physician Specialty

NDDG Diagnosis*	Diagnosis on Chart, No. (%)				Coded Diagnosis, No. (%)	
	IDDM	NIDDM	Diabetes Mellitus	Other	IDDM	NIDDM
Insulin-dependent diabetes mellitus (IDDM), n = 11	11 (100)	0 (0)	0 (0)	0 (0)	11 (100)	0 (0)
Non-insulin-dependent diabetes mellitus (NIDDM), no insulin therapy, n = 24	0 (0)	15 (68)	8 (33)	1 (4)	2 (8)	22 (92)
NIDDM plus insulin therapy, n = 38	26 (68)	8 (21)	2 (5)	2 (5)	37 (97)	1 (3)
Primary care residents	15	5	0	2		
Surgical residents	11	3	2	0		
Indeterminate, n = 5	5 (100)	0 (0)	0 (0)	0 (0)	5 (100)	0 (0)

*The diagnosis was established by criteria of the National Diabetes Data Group (NDDG).¹ "Indeterminate" refers to those cases for which insufficient information was available to assign a clear-cut diagnosis.

TABLE 3.—*Type of Diabetes Mellitus Diagnosed by Physicians (n = 34) and Students (n = 14) for Fictional Case Vignettes**

Case†	Terms Used to Diagnose Diabetes, No.						
	Insulin-Dependent	Non-Insulin-Dependent	Juvenile Onset	Adult Onset	Type I	Type II	Not Specified
Physicians							
1.....	18	1	21	0	19	0	5
2.....	27	1	3	4	20	1	1
3.....	4	17	0	22	1	23	0
4.....	0	23	0	12	0	19	7
Students							
1.....	6	0	8	0	9	0	2
2.....	7	4	2	5	4	5	0
3.....	2	8	0	10	2	10	0
4.....	0	9	1	7	1	8	0

*Multiple answers were allowed, so columns add up to more than total number.

†Cases 1 and 2, as described in text, had insulin-dependent diabetes mellitus; cases 3 and 4 had non-insulin-dependent diabetes mellitus.

incorrectly identified juvenile-onset diabetes or the term type II diabetes.

Overall, incorrect terms were chosen by 4% of the respondents for case 1, 23% for case 2, 19% for case 3, and 4% for case 4. For all cases, the terms IDDM or NIDDM were chosen and used correctly in only 60% of the answers. Physicians and medical students in internal medicine are somewhat confused by the plethora of terms available for the types of diabetes, especially for insulin-treated adult patients.

Patient Survey

Of 45 patients attending the residents' clinic in internal medicine identified as having diabetes and given the questionnaire, 33 completed it. The three patients with IDDM checked their condition as juvenile-onset diabetes, two as IDDM, and one as type I (all used some correct term, multiple answers allowed). Of the eight patients with NIDDM on no insulin therapy, six checked adult-onset diabetes (the other 2 were unfamiliar with the terms juvenile- or adult-onset diabetes), two checked type II (the other 6 were unfamiliar with this term), four checked NIDDM, two checked IDDM (even though they were not on insulin therapy), and two were not familiar with these terms.

Of the 22 patients with NIDDM on insulin therapy, 14 used the term adult-onset diabetes, with the remainder being unfamiliar with these terms; 7 checked type II, 1 type I, and the other 14 were unfamiliar with these terms; and 3 checked NIDDM, 17 IDDM, and 2 were unfa-

iliar with these terms. Thus, 100% of patients choosing between juvenile- or adult-onset diabetes chose the correct term; 88% of those choosing between types I or II were correct, but only 15% of those choosing between IDDM or NIDDM were correct. Overall, of the 21 patients saying they had IDDM, only 3 (14%) definitely had it.

Public Survey

About 148 questionnaires were distributed, of which 44 were returned completed. For case 1, 40 identified a correct term (Table 4). Of 10 respondents who had diabetes, 9 chose an appropriate term. For case 3, only 6 chose a combination of correct terms. All used the term adult-onset diabetes correctly, but only 5 of 33 choosing between IDDM and NIDDM chose the correct term. Likewise, of 19 choosing between types I and II, only 14 were correct. Of the ten with diabetes, only one chose correct terms. Overall, of those choosing IDDM or NIDDM, 63% used these terms correctly (albeit only 15% used these terms correctly for an obese adult with diabetes not prone to ketosis and on insulin therapy).

Discussion

Much effort has been expended over the years to devise succinct and accurate labels for the different types of diabetes. Clinically, two major subgroups, long known as juvenile-onset and adult-onset diabetes, have been noted, but these terms were sometimes misleading. Alternative terms, type I and type II, then insulin-dependent and non-insulin-dependent diabetes, are now used.¹ Whereas

TABLE 4.—*Survey of Laypersons' Understanding of Terms for Diabetes Mellitus (n = 44)**

Case†	Terms Used for Diabetes Mellitus						
	Insulin-Dependent	Non-Insulin-Dependent	Juvenile-Onset	Adult-Onset	Type I	Type II	Not Specified
1.....	22	3	37	0	21	0	0
3.....	28	5	0	25	5	14	4
4.....	2	28	4	23	5	10	0

*Multiple answers were allowed, so columns add up to more than total number of respondents.

†Case 1, as described in text, had insulin-dependent diabetes mellitus; cases 3 and 4 had non-insulin-dependent diabetes, with case 3 on insulin therapy. Case 2 used terms considered too technical for laypersons and thus was not included.

these last terms are now widely used, they are probably even less acceptable than the previous “juvenile-type” and “adult-type” diabetes were, as patients, physicians, and medical records coders frequently use these terms incorrectly. Although true IDDM was almost always correctly identified as such in this study by patients, physicians, and coders—as was NIDDM requiring diet or oral agent therapy—patients with NIDDM on insulin therapy were misidentified as often as not. It is exceedingly difficult to teach physicians to use these terms correctly: The medical students had had at least two to three hours of lecture in the second year on the clinical aspects and classification of diabetes and yet were correct only 64% of the time for any term and only 53% when choosing between IDDM and NIDDM. Patients and laypersons were even less accurate in the use of the terms. Not surprisingly, they did much better with the terms juvenile- and adult-onset diabetes. It is easy to understand why an obese patient on insulin treatment from age 60 to 70 (although taking oral agents for 10 years before that) would think that they had insulin-dependent diabetes. Explaining this concept to medical students or allied health professionals takes one to two hours and much basic science background. Moreover, there is some professional controversy in this area.² Some physicians consider that recurrent high glucose levels or hyperglycemic hyperosmolarity without ketosis is indicative of insulin dependence (not part of the National Diabetes Data Group criteria). The American Diabetes Association further confuses the issue by the following statement on type II diabetes: “Insulin may be required *at times* for control of *transient*, stress-induced hyperglycemia or hyperglycemia that persists in spite of other therapy”^{4(p5)} (emphasis added). This statement does not convey any impression that 30% to 70% of patients with NIDDM may be on long-term insulin therapy. The criteria of the National Diabetes Data Group for NIDDM are such that classifying patients on insulin therapy is often difficult.² With such disagreement among physicians, it is no wonder that patients and students so often misuse the terms.

Thus, despite more than a decade of use, the terms IDDM and NIDDM are misunderstood and misused, not only by patients and laypersons (possible patients and family members), but also by physicians. This problem seems to devolve from two sources: the terms are not inherently obvious, and many specialists disagree as to what they mean. As to the latter reason, whereas there is general agreement that diabetic patients who are prone to ketoacidosis have IDDM, physicians disagree about whether a mildly obese patient who is noncompliant with diet and who has glucose levels of 16.7 to 22.2 mmol per liter (300 to 400 mg per dl) has NIDDM or IDDM. Moreover, these terms are inadequate for another reason: they do not provide unambiguous information about cause or treatment. If anything, they cloud this issue and may produce more harm than good. For instance, an unfortunately common scenario at Texas Tech University is that of a patient with ketoacidosis-prone diabetes admitted to hospital and kept off oral intake because certain tests need to

be done, who “slips” into ketoacidosis while glucose levels are “under control” because the house staff, who are accustomed to seeing non-ketosis-prone, insulin-treated patients, monitor the glucose levels only and fail to use insulin at sufficient intervals to prevent ketoacidosis. Meanwhile, insulin is overused in obese patients with glucose levels of around 16.7 mmol per liter without an adequate emphasis on dietary and exercise management.

Other terms that have been proposed include “diabetes mellitus, predominant insulin deficiency” and “diabetes mellitus, predominant insulin resistance.”⁵ These terms more effectively convey the underlying pathophysiology and point to the management. Their awkwardness could be ameliorated by using the core terms “deficient” and “resistant.” This suggestion, however, is open to the criticism of reinforcing negative self-labeling in patients with diabetes. Another possible criticism is the difficulty of exact differentiation and diagnosis. This is not substantially different from the difficulty with currently used categories, as there are clear-cut cases of IDDM and NIDDM and more ambiguous cases. Also, they do not address etiologic categories or therapeutic differences.

Many studies have indicated that early intervention with immunosuppressants or intensive insulin therapy ameliorates the course of immunologically mediated, insulin-deficient diabetes.⁶⁻⁸ In addition, other studies show that about 15% of persons with adult-onset diabetes have immune markers (islet cell antibodies) without ketoacidosis-prone diabetes.⁹⁻¹⁴ These studies suggest that the early identification of immunologically mediated diabetes is important and that patients without diabetic ketoacidosis are at risk. Thus, a classification system that focuses on cause could be therapeutically meaningful. At any rate, testing for islet cell antibodies in patients with new-onset diabetes that is not the classic NIDDM of obesity would seem to be warranted.

The degree of insulin deficiency as manifested by C-peptide levels also appears to play a role in the appropriate management of diabetes.¹⁵⁻²⁴ Insulin resistance appears to play a major role in obese patients with diabetes.¹⁸⁻²⁵ Determining insulin resistance in patients can be complicated, but clinical measurements such as weight and possibly insulin or C-peptide levels are predictive.¹⁵⁻²⁴ Aggressive dietary management, which can often control NIDDM,²⁵ is difficult for many patients to afford—as in very-low-calorie liquid diets—or to comply with. It is unclear whether the control of glucose levels by insulin in the absence of dietary compliance is of benefit. Alternative oral agents (metformin, when available) and the use of appetite suppressants may be of more benefit for long-term management.

Another problem of the currently used terms is the mixed population of NIDDM in research studies. Thin or nonobese patients with NIDDM often have a mixture of partial deficiency (often on an autoimmune basis),^{9,21} “metabolic obesity,”²⁶ and genetic resistance. It is not surprising that studies of such patients reveal heterogeneity or findings different from those of obese patients with NIDDM, who are probably (mostly) insulin-resistant. It is

therefore important for studies of patients currently labeled as having NIDDM to provide further data on their populations including islet cell antibody studies and probably some assessment of resistance—admittedly a fluctuating variable. A classification focusing on the direct determination of these contributing causes would be important in our understanding of diabetes but may be too cumbersome for routine clinical management.

Whereas many persons with “resistant” diabetes show increased ketosis,^{27,28} only those with insulin-deficient diabetes have recurrent problems with diabetic ketoacidosis and must receive insulin at regular intervals even with normal glucose levels to prevent this. Mismanagement is common in this area, and management could perhaps be improved by a classification based on this problem—“ketoacidosis-prone” diabetes as a subgroup of insulin-deficient diabetes.

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